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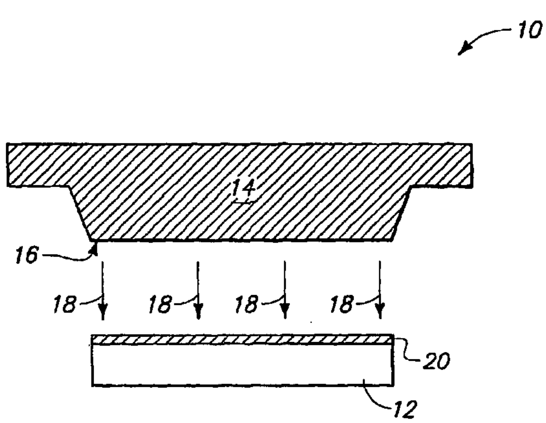
(54) **Title:** SPUTTERING TARGET CONSTRUCTIONS



(57) **Abstract:** The invention includes a physical vapor deposition target having an inner radial portion which has a radius extending from a center point of the target to an outer edge of a sputtering region. The deposition target has a flange region surrounding the inner radial portion. Two channels are positioned within the flange region with one of the channels being configured to receive an o-ring. The invention also includes a sputtering target having a flange region with a planar flange surface and having an o-ring channel disposed within the flange region. The o-ring channel has a pair of opposing channel walls and a base surface with a portion of the base surface being non-parallel relative to the planar flange surface. Invention further includes a physical vapor deposition target backing plate having an o-ring groove and a stress relief groove, and target assemblies which utilize such backing plate.

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SPUTTERING TARGET CONSTRUCTIONS

TECHNICAL FIELD

[0001] The invention pertains to physical vapor deposition targets, physical vapor deposition target backing plates and physical vapor deposition target assemblies.

BACKGROUND OF THE INVENTION

[0002] Physical vapor deposition (PVD) is commonly utilized for forming thin layers of material across a variety of substrates, including but not limited to, semiconductor substrates. Fig. 1 diagrammatically illustrates a PVD process. An exemplary PVD system 10 is shown having a substrate 12 positioned proximate a PVD target 14. System 10 can utilize a monolithic target such as target 14 depicted, or alternatively can utilize a target assembly comprising a target and a backing plate (discussed further below). System 10 is not limited to a particular type of system or apparatus. Target 14 or an alternative target/backing plate assembly can have any of a number of configurations suitable for retaining the target within a desired sputtering apparatus.

[0003] Target 14 can comprise any suitable composition, and in the shown application comprises a conductive material. It is to be understood that the target can comprise any suitable construction for forming a desired film, and accordingly can also comprise non-conductive materials, such as for example, ceramic materials.

[0004] An exposed surface 16 of target 14 can be referred to as a sputtering surface. During a sputtering event, high energy particles generated by an RF plasma, for example, are impinged upon surface 16. The impingement causes displacement of material from target 14. The released material is diagrammatically illustrated by arrows 18. The released material forms a thin film 20 across an upper surface of substrate 12.

[0005] For purposes of the present description, the side of target 14 which includes sputtering surface 16 can be referred to as a front side of the target. Similarly, an opposing target surface 17 can be referred to as being on the back side of target 14.

[0006] During a sputtering process, substrate 12 is typically placed at a defined distance opposite surface 16. For maximization of uniformity of film 20, the distance between the surface of substrate 12 and sputtering surface 16 should be a uniform fixed distance. However, in addition to erosion of the target by impingement of high energy particles, a portion of the energy of the particles is dissipated as thermal energy into the target material. Accordingly, the temperature of target 14 increases during the sputtering process. Some PVD systems are configured to remove some of the thermal

energy from the back side of the target or target/backing plate assembly utilizing a cooling circuit which typically comprises a water flow. As a result of the preceding factors the entire target is at an elevated temperature during deposition, with the target face being considerably hotter than the back side of the target. The temperature differential in the target leads to varied amounts of thermal expansion throughout the target and can result in a bowing effect. The bowing effect is enhanced in systems where pressurized water cooling is utilized on the back side and a vacuum is present at the opposing sputtering surface.

[0007] One effect of the bowing or warping of the target is a change in the defined spacing between sputtering surface 16 and substrate 12. The change in spacing can result in non-uniformity of film 20 and can also contribute to unwanted discharge (arcing) within the sputtering chamber. Arcing can in turn contribute to particulate inclusion in film 20.

[0008] In addition to the factors indicated above, the degree of target warping or bowing can be additionally affected by changes in chamber temperatures that occur both during and between sputtering events. For example, upon completion of a sputtering event, a particular substrate is removed from the chamber and exchanged for the next object to be coated. Typically, during substrate exchange the RF plasma generation is halted while the cooling circuit (if any) is maintained. As a result, the temperature differential throughout the target can change and thereby change the amount of bowing present in the target. The end result can be a cyclical variance in the amount of target bowing resulting in target motion during the sputtering event. The motion that occurs can further affect the uniformity of the resulting film.

[0009] In addition to affecting target-to-substrate spacing, motion and/or deflection of the target during sputtering can affect the condition of the target and the condition of other PVD apparatus components. For example, when a target such as target 14 shown in Fig. 1, or alternatively a target/backing plate assembly, is mounted within a PVD chamber, a portion of one or more surfaces of the target and/or backing plate can be in contact with interfacing surfaces of the PVD apparatus. The motion cycle of the target as described above can cause rubbing to occur at various target/apparatus interfaces. For example, in particular systems a portion of the front side of the target, typically near the o-ring groove (discussed below), contacts an insulating ceramic ring located at the interface between a wall of the PVD chamber and the mounted target (not shown). Motion of the target due to temperature fluctuations

and/or compressive stress can result in rubbing which can lead to contamination of the target by ceramic material and damage to the ceramic ring. These negative effects can be intensified where larger targets or target assemblies are utilized or by utilization of increased power for deposition due to the increase in compressive stress.

[0010] It is desirable to develop target constructions and methods for reducing compressive stress, decreasing target deflection and decreasing target motion that occurs in PVD processes.

SUMMARY OF THE INVENTION

[0011] In one aspect the invention encompasses a physical vapor deposition target having an inner radial portion which has a radius extending from a center point of the target to an outer edge of a sputtering region. The deposition target has a flange region surrounding the inner radial portion. Two channels are positioned within the flange region with one of the channels being configured to receive an o-ring.

[0012] In one aspect the invention encompasses a sputtering target having a flange region with a planar flange surface and having an o-ring channel disposed within the flange region. The o-ring channel has a pair of opposing channel walls and a base surface with a portion of the base surface being non-parallel relative to the planar flange surface.

[0013] In one aspect the invention encompasses a physical vapor deposition target backing plate having an o-ring groove and a stress relief groove. In another aspect the invention encompasses a sputtering target assembly which includes a physical vapor deposition target having an o-ring groove and a stress relief groove.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Preferred embodiments of the invention are described below with reference to the following accompanying drawings.

[0015] Fig. 1 is a diagrammatic cross-sectional view of a PVD deposition system and shows a PVD target construction proximate a substrate.

[0016] Figs. 2 and 3 are a diagrammatic top view and cross-sectional view, respectively, of a PVD target construction in accordance with one aspect of the present invention.

[0017] Fig. 4 is a diagrammatic top view of a PVD target in accordance with one aspect of the invention.

[0018] Fig. 5 is a diagrammatic top view of a PVD target having an alternative configuration relative to that shown in Fig. 4.

[0019] Fig. 6 is a diagrammatic cross-sectional side view of a PVD target/backing plate construction according to one aspect of the present invention.

[0020] Fig. 7 is a diagrammatic cross-sectional view of a target construction in accordance with a second aspect of the present invention.

[0021] Fig. 8 is a diagrammatic cross-sectional view of a portion of a target construction in accordance with an aspect of the invention.

[0022] Fig. 9 is a diagrammatic cross-sectional view illustrating alternative o-ring groove configurations in accordance with an aspect of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] One aspect of the invention is to develop methodology for overcoming or minimizing target bowing that occurs during sputter deposition and to thereby improve the uniformity of the resulting thin films. This aspect of the invention is described with reference to Figs. 2 through 4. Referring initially to Fig. 2, such shows a front side view of a target 14. Target 14 as shown in Fig. 2 is a monolithic target which can be mounted for sputtering without the use of a backing plate. Alternative exemplary target constructions in accordance with the present invention are presented in later figures.

[0024] The monolithic target shown in Fig. 2 has sputtering surface 16 which is encircled by a mounting flange region 22. Target 14 is configured for mounting by providing mounting holes 24. Mounting holes 24 can in some instances be threaded for mounting using mounting bolts. Flange region 22 can comprise four holes 24 as shown, or can comprise any number of mounting holes as appropriate for the particular mounting configuration of the PVD system being utilized. Alternatively, target 14 can be mounted using a clamping or alternative configuration where mounting holes are not utilized and accordingly flange region 22 can be configured to lack any holes (not shown).

[0025] Target 14 can comprise an o-ring groove 26 within flange region 22. For purposes of the present description, the terms groove and channel are used interchangeably. In particular mounting configurations, o-ring groove 26 will be present as an opening in the front side of flange region 22. It is to be understood that the invention encompasses targets having alternative placement of o-ring groove 26, such as for example, at a relative distance from target edge 32 that differs from the placement shown in Fig. 2. Referring to Fig. 3, such shows a sectional side view of the target of target 14 taken along Line 3-3 of Fig. 2. As shown in each of Figs. 2 and 3, target 14 has an inner radius R_1 associated with the radius of the sputtering portion of the target,

and an overall radius R_2 which extends from a central axis designated 'C,' to perimeter surface 32 and is inclusive of flange region 22 as well as the sputtering portion of the target.

[0026] Mounting holes 24 can extend from a front side of the target 28 through the flange region to back side 30. As discussed above, the number and placement of mounting holes 24 can vary depending upon the target mounting configuration of the system. Accordingly, the relative distance of the placement of mounting holes 24 from target edge 32 can vary from that shown in Fig. 3. Similarly, the placement distance of o-ring groove 26 relative to target edge 32 can also differ from the placement shown in Fig. 3. It is to be understood that the invention additionally encompasses target constructions lacking an o-ring groove (not shown).

[0027] Referring now solely to Fig. 3, target 14 in accordance with the invention can comprise one or more grooves 38 formed within the material of target 14. Grooves 38 can be formed, for example, by machining an opening into target 14 either during or after target fabrication. Groove 38 can function to reduce target stiffness in selected areas or regions of the target. The reduction in target stiffness in selected areas can decrease the amount of warping, deflection and target motion that occurs during sputtering processes. Formation of groove 38 can be advantageous relative to alternative methods of reducing stiffness due to the relative ease of the formation of groove 38 as compared to, for example, adding material interfaces/bond lines to the target design. The alternative methods of forming interfaces and/or bond lines for stiffness reduction can be expensive as well as difficult to manufacture.

[0028] The position of groove 38 in target 14 is not limited to a specific location. A preferred general location for groove 38 can be on the back side of the target and positioned within flange region 22 between inner radius R_1 portion of the target and the position of o-ring groove 26. More preferably, groove 38 can be positioned within the flange region at the point nearest the sputtering portion R_1 of target 14 (where the flange region and the sputtering region meet). In particular aspects, it can be preferable that groove 38 be disposed along the back surface of the target and contacting or overlapping the intersection of the sputtering region and the flange. For example, the innermost wall of channel 38 can be at a distance from the target center C equivalent to R_1, or a point on the base of the channel or outer channel wall can be at the R_1 distance.

[0029] It is to be understood, that the invention encompasses alternative placement of channel 38 from that shown in Fig. 3. For example, channel 38 can be

positioned within the flange region on the front side of target 14, either toward the sputtering portion side of o-ring groove 26 or positioned toward outer edge 32 relative to o-ring groove 26 (discussed further below). An additional alternative is for groove 38 to be positioned within the flange region radially outward from the position of o-ring groove 26 along the back side of the target. In particular aspects it can be preferable that groove(s) 38 be positioned on the back side of target 14 to reduce potential of the groove(s) interfering with sputtering processes by, for example, retaining contaminant material.

[0030] As shown in Fig. 3, target 14 can comprise a single annular groove 38. The invention additionally encompasses targets comprising two or more annular grooves which can consist of entirely front side grooves, entirely back side grooves or a combination of front side and back side grooves. Further, where target 14 comprises a plurality of annular grooves, such grooves can be located radially inward relative to o-ring groove 26, radially outward of o-ring groove 26, or a plurality of grooves can comprise a mixture of radially inward and radially outward positioned grooves relative to o-ring 26.

[0031] Annular groove 38 can be a circular channel which is continuous and encircles a central portion of the target as shown in Fig. 4. In addition to continuous annular grooves 38, the invention encompasses intermittent or discontinuous grooves, channels or openings 38a such as illustrated in Fig. 5. Targets of the invention can comprise a plurality of annular channels located at differing radial distance from the target center. The plurality can comprise all continuous channels, all discontinuous channels or a combination of channel types. The multiple channels can have identical opening shapes and/or dimensions (width, depth), or can differ in shape and/or one or more dimensions. Where multiple discontinuous or intermittent channels are utilized, the length and width of openings can be the same or can differ for differing radial location.

[0032] Grooves 38 are not limited to any particular shape and can comprise, for example, a rectangular shape as depicted in Fig. 3., having side walls perpendicular to target back side surface 17 and having an opening base surface parallel to target back side surface 17 . Opening 38 can comprise one or more alternative features such as a non-symmetrical shape, one or more sidewalls non-perpendicular to the flange surface, a v-shape, an arched or rounded shape, one or more stepped side walls, can have a

non-uniform cross-sectional area and/or shape along the length of the opening (not shown).

[0033] As shown in Fig. 3, groove 38 can have an aspect ratio of greater than 1, where aspect ratio refers to the depth of the opening relative to the opening width. Alternatively, opening 38 can have an aspect ratio of less than or equal to 1. The invention additionally contemplates target constructions where groove 38 is a shallow thinning of a portion of flange region 22. Where target 14 comprises a plurality of grooves 38, the shape and/or size of the grooves can be the same or can differ.

[0034] Although Fig. 3 shows groove 38 being positioned within flange region 22 of target 14, the invention also encompasses targets having groove 38 positioned within radius R_1 portion of the target. It is to be noted that Fig. 3 depicts a target construction prior to any use of the target for sputtering purposes. Prior to use, sputtering surface 16 can be planar with inner radius R_1 region of the target having a thickness that is uniformly greater than the flange region of the target. However, erosion of the target during use causes the thickness of the inner radius portion of the target to decrease. This decrease in thickness can be non-uniform across surface 16 thereby resulting in an uneven sputtering surface.

[0035] Due to the changes in thickness and contour that occurs in the inner radial portion of the target during sputtering, a groove placed within the R_1 sputtering portion of the target can have variable effects on target stiffness over the life of the target. The variance can potentially negatively influence consistency in film quality and uniformity, as well as substrate-to-substrate reproducibility. Due to this variance, it can be advantageous to position the groove within the flange region of the target to avoid unpredictable effects on target performance. However, since targets can tend to exhibit increased bowing as a result of increased erosion over target life, selective stiffness reduction by placing groove 38 within the R_1 sputtering region of the target can decrease the effect of erosion on target bowing over the life of the target. Accordingly, the invention contemplates placing one or more grooves within the sputtering portion of the target. It can be possible to reduce bowing variance over the life of the target and also reduce the overall amount of bowing by proper combination of grooves within the flange region and the R_1 portion of target 14.

[0036] A second embodiment of the selective reduction of target stiffness aspect of the present invention is described with reference to Fig. 6. Fig. 6 illustrates an exemplary target/backing plate assembly 50 in accordance with the invention.

Assembly 50 can comprise a target portion 14 and a backing plate portion 100. Assembly 50 has features similar to those discussed with respect to the monolithic target of Figs. 2 and 3. Like features are labeled similarly with features occurring in the backing plate of Fig. 6 being increased by 100 relative to the features of the embodiment shown in Fig. 3. As shown in Fig. 6, target 14 can physically contact backing plate 100 at an interface line 137. Target 14 can be bonded to backing plate 100 by, for example, diffusion bonding. Alternatively, a bonding material can be present at interface 137 (not shown) which physically joins target 14 to backing plate 100. The invention also contemplates alternative assembly constructs where target 14 is held to backing plate 100 by mechanical or other alternative methods.

[0037] In the exemplary target assembly shown in Fig. 6, flange region 122 is present in backing plate 100 for mounting the assembly within a deposition apparatus. The presence or absence and/or positioning of o-ring 126 and mounting holes 124 can be as described above with reference to the monolithic target flange region. Similarly, one or more grooves 138 can preferably be positioned within the back side 130 of backing plate 100 within inner radius R_1 of the backing plate, or within the flange region. In particular aspects, at least one groove can be disposed within the back surface 130 in the flange region at the interface of flange and R1. Groove(s) 38 can alternatively be provided on the flange region of the front side 128 of backing plate 100.

[0038] Positioning of groove 138 for maximization of reduction in target bowing/stiffness can depend upon a number of factors such, as a composition of target 14, target microstructure, a composition of backing plate 100, backing plate microstructure, processing power utilized during the sputtering process, target size, target geometry, etc. Placement of a single groove in the back side of the flange region of a monolithic aluminum target between the inner radius R_1 and the radial position at which the o-ring groove is located can reduce stiffness and result in a decreased target bow of nearly 60% relative to an otherwise identical target lacking the groove exposed to the same sputtering conditions (as determined by Finite Elemental Modeling). A greater reduction in bowing may be possible by increased groove depth (relative to the modeling studies). The reduction in bowing can provide improved uniformity in the resulting films and can provide improved step coverage for gap-fill and other high aspect ratio applications.

[0039] An alternative reduction of stiffness in selected areas of the target can be accomplished by heat treating the flange area of target 14 differently relative to the heat

treatment performed on the sputtering (R_1) target area. Such differential heat treatment can be utilized independently or can be combined with the selective placement of stiffness reduction groove(s) 38 described above.

[0040] Fig. 7 shows a monolithic target 14 similar the target of Fig. 3. However as shown in Fig. 7, in particular instances stress relief groove 38 can be positioned on front side 28 of flange region 22. Such groove placement can relieve or decrease compressive stress and/or target motion that occurs during the sputtering process. In particular mounting configurations, the front side of flange portion 22 can contact other PVD apparatus components such as, for example, an insulating ceramic ring. Motion and/or compressive stress that occurs during the sputtering process can result in damage to the ceramic ring and can additionally result in contamination of target 14 by ceramic material. Groove 38 can be positioned along the front face of flange 22 to maximize stress relief, decrease contamination and minimize or prevent damage to the ceramic ring.

[0041] Stress relief groove 38 can be a single groove as shown in Fig. 7 or can be multiple grooves which can be rectangular or alternatively shaped. An exemplary multi- groove stress relief configuration in accordance with the invention is illustrated in Fig. 8. The depicted multi-groove target shown has two stress relief grooves, with one being positioned on either side of o-ring groove 26. Fig. 8 additionally illustrates an optional reset feature where a portion of flange surface 40b is recessed relative to the plane of an outer flange surface 40 (the imaginary extension of the plane of outer surface 40 being illustrated by dashed line 40a). Recessed surface 40b can be angled creating a gradient recess as shown in the figure or can be recessed to have one or more sections parallel to line 40a (e.g. stepped, not shown).

[0042] The invention additionally contemplates adaptation of the dual or higher order groove configuration, such as by modification of the exemplary dual groove configuration shown in FIG. 8, to allow stiffness reduction in a variety of target configurations. Such adaptation can include altering the position of the grooves relative to each other and/or relative to the o-ring groove, altering groove shape, altering grove aspect ratios, or any combination of these features.

[0043] In addition to stress relief groove 38 described above, which is independently positioned with respect to the o-ring groove 26, the invention additionally encompasses embodiments where the stress relief feature is incorporated into o-ring groove 26. Such incorporation can involve change in depth and/or shape of o-ring

groove 26. Exemplary alternative o-ring groove configurations are shown in Fig. 9. In particular aspects of the invention, an o-ring groove 26a can have a base surface 25 which is parallel to planar flange surface 40, and can have sidewalls 27 which are non-parallel relative to each other and/or non-parallel relative to planar surface 40. The invention also contemplates having base surface 25 remain parallel to the plane of surface 40 (i.e. line 40a of Fig. 8) in embodiments where a portion of the flange surface is recessed (not shown).

[0044] As further illustrated in Fig. 9, the incorporation of stress relief feature into the o-ring groove can comprise forming o-ring groove such that at least a portion of a base surface of the o-ring groove is not parallel with the surface of the flange region, such as exemplary grooves 26b, 26c, shown having base surfaces 25b, 25c. In other words, the o-ring groove can be formed such that the depth of the o-ring groove varies along at least a portion of its width. Where a portion of the flange surface is recessed (such as depicted in Fig. 8) the base surface of the o-ring groove can be parallel to the recessed surface or can alternatively be angled relative to the recessed surface.

[0045] The invention also contemplates alternative positioning of the o-ring groove to selectively reduce stress at particular target locations. The introduction of such stress relief features to o-ring channel 26 can relieve stress to decrease or eliminate compressive stress, target motion and/or deflection that can cause rubbing of the target (or target assembly) with contacting surfaces of other PVD apparatus components.

[0046] The various aspects of the invention discussed above can be used individually or can be combined. For example, the reduced stiffness aspect utilizing one or more stiffness-reducing channels can be combined with the stress relief o-ring configurations of the invention to minimize target motion, minimize target bowing and to minimize compressive stress and the effects thereof.

[0047] Target assemblies can be formed to comprise any of the o-ring groove configurations described above. For example, the o-ring grooves described can be incorporated into a backing plate (e.g. in place of o-ring groove 126 of Fig. 6) and can be used independently or in combination with one or more stiffness reduction channels (e.g. channel 138 of Fig. 6).

[0048] The described target configurations of the invention can selectively reduce stiffness in a particular area of a target by positioning of one or more channels. Reduced target stiffness can decrease or eliminate target bowing during physical vapor

deposition processing. The target configurations described can be particularly advantageous for use in physical vapor deposition processing systems which utilize magnets disposed behind the target (relative to the substrate). Target bowing can bow the target away from the magnets and thereby affect the uniformity of the magnetic field strength across the sputtering surface. This effect can be most problematic where the target comprises magnetic materials. Accordingly, the reduced bowing afforded by the described target configurations can assist in maintaining a uniform magnetic field strength across the target surface throughout the sputtering process, and can be especially advantageous for targets comprising magnetic materials.

[0049] Although the invention is described with reference to planar circular targets, the inventive concepts are equally applicable to other target geometries and to targets having a non-planar initial sputtering surface. Utilization of targets in accordance with the invention can allow increased reproducibility in film quality and can increase uniformity in the sputtered films.

CLAIMS

The invention claimed is:

1. A physical vapor deposition target comprising:

an inner radial portion having a radius extending from a center point of the target to an outer edge of a sputtering region;

a flange region surrounding the inner radial portion;

a first channel within the flange region configured for receiving an o-ring; and

a second channel within the flange region.

2. The target of claim 1 wherein the second channel is disposed radially outward relative to the first channel.

3. The target of claim 1 wherein the second channel is disposed radially inward relative to the first channel.

4. The target of claim 3 wherein the first channel and the sputtering surface are commonly disposed on a first face of the target.

5. The target of claim 3 wherein the first channel and the sputtering surface are disposed on opposing sides of the target.

6. The target of claim 1 wherein the second channel is a continuous channel encircling the target.

7. The target of claim 1 wherein the second channel is a discontinuous channel encircling the target.

8. The target of claim 1 wherein the first channel is disposed on a first face of the target and wherein the second channel is disposed on an opposing second face of the target.

9. The target of claim 1 wherein the target comprises a first face and an opposing second face and wherein the first and second channels are commonly disposed on the first face.

10. The target of claim 9 wherein the sputtering surface is disposed on the first face of the target.

11. The target of claim 9 wherein the sputtering surface is disposed on the opposing second face of the target.

12. The target of claim 1 further comprising a third channel within the flange region.

13. The target of claim 12 wherein the second channel and the third channel are disposed on a common face of the target.

14. The target of claim 12 wherein the second channel and the third channel are disposed on opposing target surfaces relative to each other.

15. A sputtering target comprising:

a sputtering region;

a flange region extending radially outward from the sputtering region;

an o-ring groove disposed within the flange region; and

a stress relief groove radially inward relative to the o-ring groove.

16. The target of claim 15 further comprising a sputtering surface within the sputtering region and wherein the sputtering surface is disposed on a front side of the target and the stress relief groove is disposed on an opposing back side of the target.

17. The target of claim 15 wherein the sputtering region is defined by a radius extending from the center of the target to an outermost edge of the sputtering region and wherein a portion of the stress relief groove lies within the radius of the sputtering region.

18. The target of claim 15 wherein the sputtering region is defined by a radius extending from the center of the target to an outermost edge of the sputtering region and wherein the stress relief groove lies entirely within the radius of the sputtering region.

19. The target of claim 15 wherein the sputtering region is defined by a radius extending from the center of the target to an outermost edge of the sputtering

region and wherein an inner edge of the stress relief groove contacts the outermost edge of the sputtering region.

20. A sputtering target comprising a flange region having a planar flange surface and having an o-ring channel disposed within the flange region, the o-ring channel comprising a pair of opposing channel walls and a base surface, at least a portion of the base surface being non-parallel relative to the planar flange surface.

21. The sputtering target of claim 20 wherein at least a portion of the opposing walls are non-parallel relative to each other.

22. The sputtering target of claim 20 wherein at least a portion of the opposing channel walls are non-perpendicular relative to the planar surface.

23. A sputtering target comprising a flange region having a planar flange surface and having an o-ring channel disposed within the flange region, the o-ring channel comprising a first channel wall and a second channel wall opposing the first channel wall, at least a portion of the first channel wall being non-perpendicular relative to the planar flange surface.

24. The target of claim 23 further comprising an initial sputtering plane defined by a sputtering surface prior to use as a target, and wherein the planar flange surface is parallel to the initial sputtering plane.

25. A physical vapor deposition target backing plate comprising an o-ring grove and a stress relief groove.

26. The backing plate of claim 25 wherein the o-ring grove is dispose on a front side of the backing plate and wherein the stress relief channel is disposed on an opposing back side.

27. The backing plate of claim 25 wherein the o-ring grove and the stress relief channel are each disposed on a common side of the backing plate.

28. The backing plate of claim 25 wherein the stress relief channel is a first stress relief channel and wherein the backing plate further comprises a second stress relief channel.

29. The backing plate of claim 28 wherein the first stress relief groove is disposed on a first side of the backing plate and the second stress relief channel is disposed on an opposing second side.

30. A physical vapor deposition target assembly comprising the backing plate of claim 25.

31. A backing plate for a sputtering target, the backing plate comprising a flange region having a flange surface, an o-ring groove being disposed within the flange surface and having a pair of sidewalls and a base surface, at least a portion of the base surface being non-parallel to the flange surface.

32. The backing plate of claim 31 wherein at least a portion of the sidewalls are non-parallel relative to each other.

33. The backing plate of claim 31 wherein at least a portion of the sidewalls are non-perpendicular relative to the flange surface.

34. The backing plate of claim 31 further comprising at least one channel.

35. A method of selectively reducing stiffness in an area of a sputtering target comprising:

providing a sputtering target having an o-ring groove; and
introducing at least one channel spaced from the o-ring groove.

36. The method of claim 35 wherein the at least one channel comprises a first channel disposed on a first side of the sputtering target.

37. The method of claim 36 wherein the sputtering target comprises a flange region and wherein the first channel is disposed within the flange region.

38. The method of claim 36 wherein the o-ring groove is disposed on the first side of the sputtering target.

39. The method of claim 36 wherein the o-ring groove is disposed on a second side of the sputtering target.

40. The method of claim 36 wherein the at least one channel further

comprises a second channel.

41. The method of claim 40 wherein the second channel is disposed on the first side of the sputtering target.

42. The method of claim 40 wherein the second channel is disposed on a second side of the sputtering target.

43. The method of claim 35 wherein the reduced stiffness provides reduced target motion during sputtering processes relative to an otherwise identical target which lacks the at least one channel.

44. The method of claim 35 wherein the reduced stiffness provides reduced rubbing between a surface of the sputtering target and an interfacing surface comprised by a sputtering apparatus during sputtering processes relative to an otherwise identical target which lacks the at least one channel.

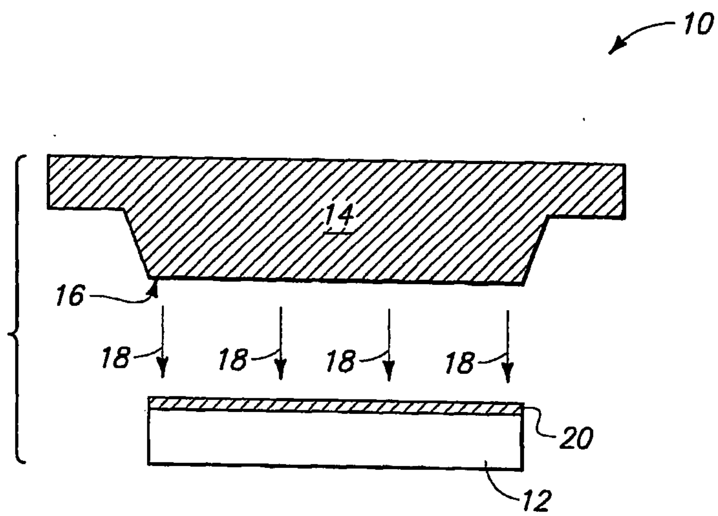


FIG 1

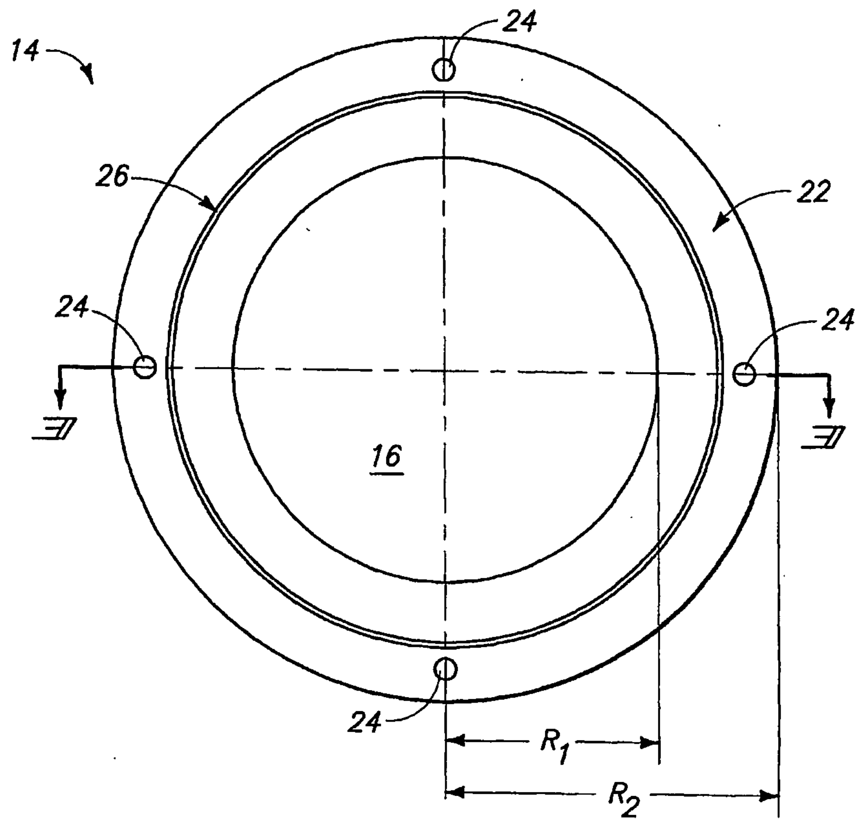

14
24
26
22
24
24
3
3
16
24
R_1
R_2

Fig 2

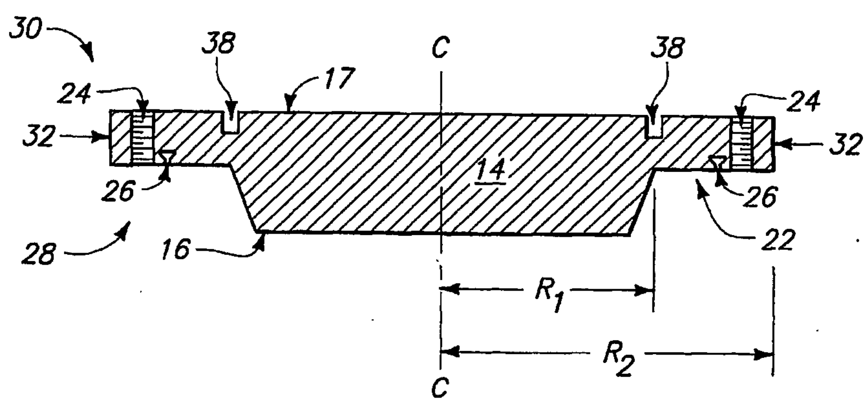

30
38
C
38
17
24
24
32
32
14
26
26
28
16
22
R_1
R_2
C

Fig 3

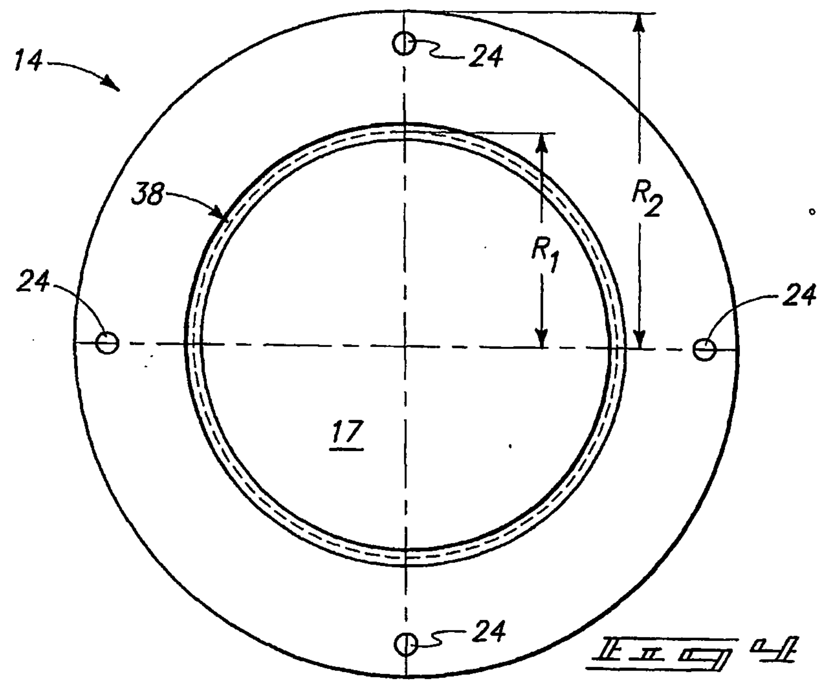


FIG. 4

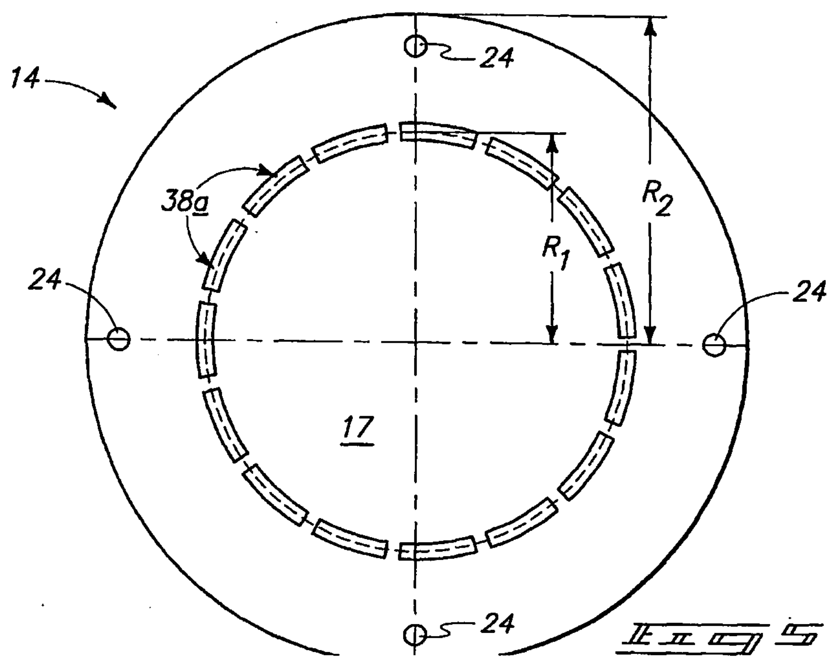


FIG. 5

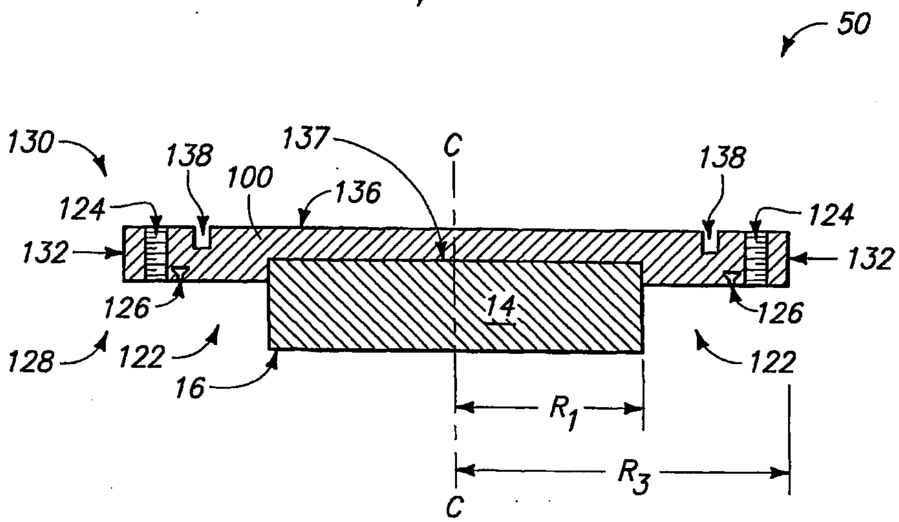
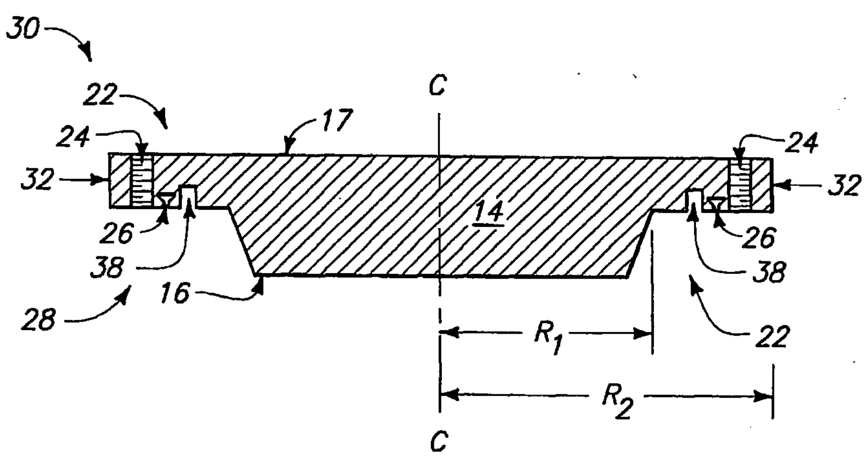

50
130
138
137
C
138
100
136
124
124
132
132
14
126
126
128
122
122
16
R1
R3
C

FIG. 6


30
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C
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24
24
32
32
14
26
26
38
38
16
28
22
R1
R2
C

FIG. 7

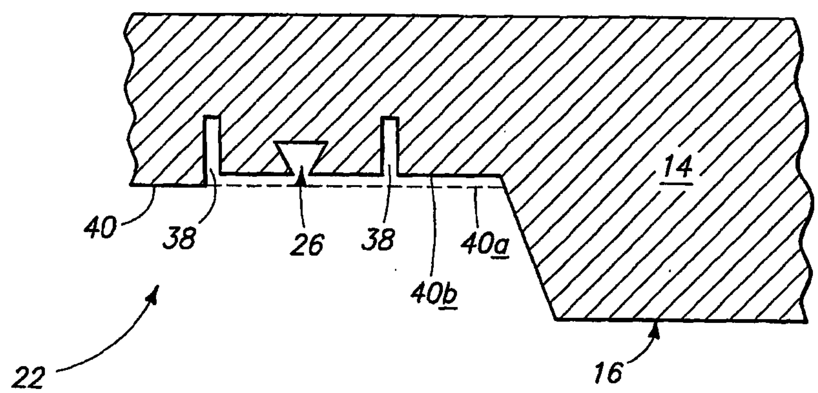
14
40
38
26
38
40a
40b
22
16

Fig 8

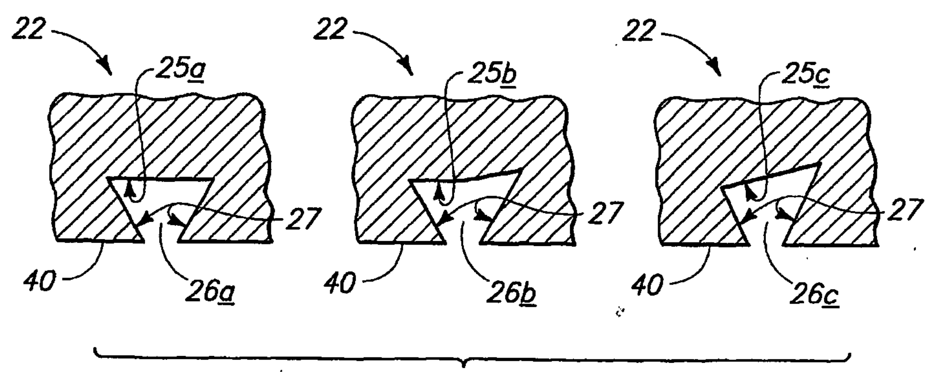
22
25a
27
40
26a
22
25b
27
40
26b
22
25c
27
40
26c

Fig 9

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/021362

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C23C14/34 H01J37/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C23C H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00/32347 A (TOSOH SMD INC ; BARDUS STEVEN L (US); BARNES WILLIAM E (US); HOLCOMB M) 8 June 2000 (2000-06-08)	1-6,9, 11,15, 23-25, 27,30, 35-38, 43,44
	page 6, line 11 - page 7, line 18; claims; figures 2,3	
X	WO 96/36065 A (MATERIALS RESEARCH CORP) 14 November 1996 (1996-11-14)	23,24
Y	page 12, line 11 - line 25; claims; figure 4	1-44
X	US 5 738 770 A (GILMAN PAUL S ET AL) 14 April 1998 (1998-04-14)	23,24
Y	column 3, line 23 - column 4, line 13; claims; figures	1-44

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 2004	19/11/2004

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 474 667 A (HURWITT STEVEN D ET AL) 12 December 1995 (1995-12-12) column 1, line 28 - column 2, line 11; claims -----	1-44
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